OPTIMALIZATION OF MAGNETIC ELECTROSTIMULATOR ELECTRODE FOR NON INVASIF ACCUPUNCTURE THERAPY EFFECTIVITY

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ABSTRACTS

Electroaccupuncture therapy is electrical energy stimulation at accupuncture points. This method is implemented by placing electrode needle inserted at accupuncture points. The flow of energy from the source of stimulation that is electrostimulator which will stimulate the body's meridian system of the patient in order to achieve energy balance. Non-invasive therapy, such as the installation of metal electrodes on the surface of the skin. This study aims to produce a magnetic electrode to the effectiveness of acupuncture therapy. Research methods include designing, creating and testing electrostimulator magnetic electrode at various magnetic field strengths. Research result showed that of the most effective of the electrostimulator electrode for non-invasive therapies are acupuncture electrode with strong magnetic fields> 120 mT. These electrodes produce a small output voltage (70 V) which does not cause pain.

Key word: electro acupuncture therapy, non invasive, magnetic electrode

1. INTRODUCTION

Acupuncture therapy is one of the traditional methods of therapy that originated in China. In principle, this therapy seeks to restore the energy balance in the body. The imbalance of energy in a body system is resulting in disruption of the physiological function of these organs. Methods of acupuncture therapy attracted many people in Indonesia because the effectiveness of the therapy is good and relatively cheap cost. A variety of equipment and methods of acupuncture therapy has been developed according to the progress of technology [1].

One method that many do acupuncture therapy is electro acupuncture. This treatment method has advantages in terms of effectiveness and cost of therapy (operational costs and the tool price is relatively cheap). The main drawback of this therapy is pain arising as a result of the puncture needle to acupuncture points [2].

Electro-acupuncture stimulation therapy is electrical energy at acupuncture points. This method is inserted a needle electrode at acupuncture points. The electric energy from the source of stimulation (electrostimulator) will flow to the body's meridian system of the patient. to achieve energy balance. Electrostimulator is an electronic device that generates electrical wave with wave shape, intensity, and specific frequencies. The magnitude of each variable is adjusted to the needs and the type of treatment performed [3].

Non-invasive methods of treatment such as the installation of metal electrodes on the skin surface aims to avoid the onset of pain caused by acupuncture needle prick. The weakness of the method is non-invasive therapy reduced effectiveness. In this research, a modified electrostimulator electrode, the form of magnet that is expected to increase the effectiveness of therapy, without the pain of the puncture. This study aims to produce a magnetic electrode to the effectiveness of acupuncture therapy. The magnetic field in this type of electrode works to increase the current flow in the meridians, thus also increasing the effectiveness of therapy[4].

2. MATERIAL AND METHODS

The set-up of magnetic electrostimulator electrode

Magnetic electrode assembly system originated from a pulse source oscillator circuit using principal component IC NE 555. Frequency and pulse width output of this circuit relies on a combination of the RC value specified [5].

Oscillator or multivibrator output is connected to the signal processor to obtain the pulse circuit that is used to control the voltage of a transformer folder. The system is controlled by a transistor transformer work. The output voltage pulse transformers are expected to spike-shaped, with a narrow pulse width and height [6]. A narrow spike pulse is effective voltage value is much smaller than the generated peak voltage, so that better treatment effectiveness. In addition to the folder voltage, the transformer also functions as an isolated circuit. Such a system guarantees the safety of therapy, because there is no direct current flowing in the patient.

Output voltage of the transformer is connected to a pair of electrodes attached to the patient's skin surface. Electrode used is stainless metal pieces attached by neodynum magnets to produce stumulasi electric and magnetic field [7]. System block diagram of a non-invasive electro acupuncture with magnetic electrodes are shown in Figure 1.

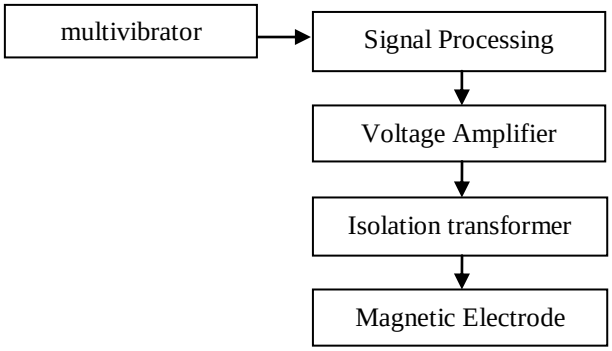

Figure 1: Block Diagram of a non-invasive electro acupuncture with magnetic electrodes

Results and Discussion

The results of the electromagnetic magnetic electrode is shown assembly in Figure 2.

Figure 2. Magnetic electrostimulator electrode assembly results

The results of performance testing of magnetic electrodes that have been assembled in the form of data relationships magnetic field strength and the threshold voltage output, shown by Table 1.

Table 1. Data relationships of magnetic field and the output threshold voltage of the electrode magnets

No	Pieces of magnet	Magnetic fields	Output voltage (V)
	Without magnet	33 mT	110
1	A piece of magnet	98,6 mT	130
2	2 pieces of magnet	129,7 mT	70
3	3 pieces of magnet	140,8 mT	70
4	4 pieces of magnet	147,2 mT	70
5	5 pieces of magnet	150,3 mT	-

The results showed that the use of a magnetic field on the electrode electrostimulator above 120 mT generates a smaller output voltage with a large resistance value so the possibility of damage to the cells in a small body [4].

Electrostimulator is an electronic device that provides electrical stimulation to the body with the waveform, intensity, and specific frequencies [3]. Electrostimulator serves as a source of electrical stimulation of the body is able to create a balance bioenergy. The electrostimulator principle on acupuncture therapy stimulates acupuncture points by using pulses of electric current, because each type of pulse has different characteristics that affect the safety and effectiveness of therapy. The effectiveness of therapy depends on the electro stimulator on the waveform, the magnitude of the intensity (voltage and current), frequency, and timing of stimulation.

Wave Form of electrostimulator

Waveform which resulted by electrostimulator is a voltage versus time curve. In general, wave of electrostimulator is relatively small width pulses [7]. Because the fluid body is an electrolyte, the potential provision monofase resulted in polarization around the electrode, thereby reducing the effectiveness of the electrical stimulation.

The selection of width pulse a relatively small is easily the analysis of cell response to stimuli, because the artifacts are relatively thin / sharp. But if it is too small, the energy supplied is not able to produce the expected action potential [3]. This is related to the mechanism of action potential generation that is completed or failed (all or none), ie when the energy levels are given above the energy threshold of action potentials will be generated as a whole, but if the energy is below the energy threshold of the action potential will occur [8] [9].

The form of biphasic waveform be applied to reduce the effect of the polarization Waveforms are commonly used for acupuncture therapy is a form of spike pulses that give the effect of high arousal and painless. Some types of biphasic waveform used include square shape (square-wave), sinusoidal, ripple-wave, saw-tooth wave, and burst-wave [2].

Frequency of electrostimulator

Frequency of electroaccupuncture is the number of waves per unit time given certain. It usually used unit pulses per second or Hz, which is 1 pulse per second. Electrostimulator take an important role in such frequency. This relates to the purpose of the treatment given. The use of low frequency aimed to increase energy, while the high frequency to attenuate. Even with the higher frequencies can be obtained by the effects of anesthesia [10].

Intensity of Electrostimulator

Electrostimulator intensity is closely related to the magnitude of the voltage generated of the device. The body has a certain resistance and impedance, so giving the power supply voltage that will cause the flow of electric current which is proportional to the magnitude of the voltage and inversely proportional to the resistance [10].

Intensity of a given magnitude affects the effectiveness of the therapy is done. The applied of higher voltage means increasing electricity is transferred into the patient's body. But granting excessive intensity also contains the risk of ionization in the area around the mounting electrode, and the possible effects on cardiac fibrillation [9].

Electrical energy dose

One important factor that determines the success of therapy with dosing accuracy electrostimulator energy is given to each treatment. If the terms of the output waveform spike (Figure 3), the effective output voltage (V_{eff})[3]:

$$V_{eff} = \sqrt{\frac{1}{12}} . V_p 2. s . f$$

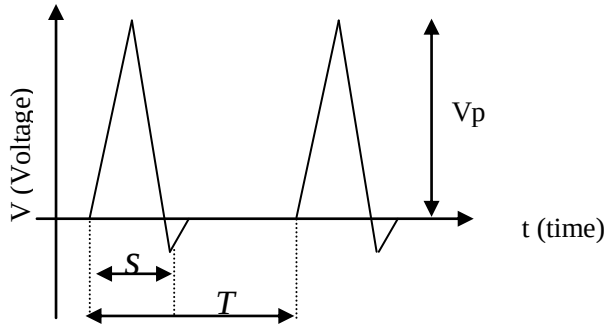

Figure 3. Spike pulse

with : s = pulse width

$T = \frac{1}{f}$ = pulse periode

Vp = peak voltage

f = frequency

The theoretically power can be calculated by the equation :

$$P = \frac{V_{eff}^2}{R}$$

with R = resistance (for the body about 500 Ω)

The dose of energy (E) which enters the body each time (t) can be calculated by the equation:

$$E = P.t$$

Stimulation of electrical energy supplied to the acupuncture therapy is done by inserting acupuncture needles which serves as a conductor between the acupuncture point and stimulator electrode. This therapeutic method known as invasive therapy. The advantages of such a method of therapy is the flow of electric current from electrostimulator directly on acupuncture points, which have a relatively small resistance. The low resistance affected voltage applied is relatively low, so it have high electrical energy efficiency [4].

The weakness of invasive therapy method is not all patients be able and willing pierced with needle acupuncture. This is one reason patients are reluctant to perform acupuncture therapy due to fear when it should be pricked with acupuncture needles [4]. The acupuncturist can also perform non-invasive therapy to anticipate the fear of acupuncture needles, ie by placing the metal electrode on the surface of the skin over acupuncture points.

Installation of electrodes on the surface of the skin causes the flow of electric current must electrostimulator through the layers of skin that have a relatively greater resistance [9]. In order to achieve the targeted acupuncture points, then the voltage that must be generated by electrostimulator also much larger [3]. Limitations the value of the maximum voltage that can generated electrostimulator is a constraint that is often encountered in the implementation of the non - invasive therapy method [4].

Based on the results of research conducted by the installation of a magnetic electrodes on acupuncture points, they are causing in a decrease of resistance between the electrodes attached to the acupuncture points. Magnetic electrode resulted a decrease in voltage and electrical stimulation energy [10]. The results of this study further add to the diversity of implementation acupuncture with electrical stimulation energy methods or electro-acupuncture therapy. Installation of magnetic electrode stimulation in addition to improving energy efficiency and comfort also improves the effectiveness of acupuncture therapy is non – invasive [4].

Conclusion

Research result showed that of the most effective of the electrostimulator electrode for non-invasive therapies are acupuncture electrode with strong magnetic fields > 120 mT. These electrodes produce a small output voltage (70 V) which does not cause pain.

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